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Color Films, Plates
and Filters
for
Commercial Photography



Eastman Kodak Company
Rochester, N. Y.



IF THIS BOOK
SHOULD STRAY OR ROAM
SPANK IT GOOD
AND SEND IT HOME

**MACKLYN
de NEHL
STENGLER**

Color Films, Plates
and Filters
for
Commercial Photography

Property of
Macklyn Stangler
2023 Pelham Ave.
Westwood - L. A. Cal.

Eastman Kodak Company
Rochester, N. Y.
1925

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Introduction

EVERY photographer who photographs colored objects should know how to make negatives that will faithfully record the monochrome values of the colors.

Whether the subject is in one color against a background of another color or whether it contains two or more colors, he should be able to determine, from an examination of the subject, whether it is necessary to use color sensitive materials and whether an orthochromatic filter should be employed or a panchromatic film with either an orthochromatic or a contrast filter.

Photographs that faithfully produce, in monochrome, the relative brightness of the colors of the subject are an absolute necessity for catalogue and book illustrations and for use by salesmen who cannot carry samples of the objects the photographs represent.

The making of such photographs is a comparatively simple matter when once the principles involved are understood and in this booklet we undertake to make these principles clear.

Should any question arise in connection with the subject, that we have not answered in these pages, we will be glad to deal with it by correspondence.

EASTMAN KODAK COMPANY,
ROCHESTER, N. Y.

December, 1925

Photographing Colors

FROM the earliest days of photography it has been recognized that the effect obtained when colored objects are photographed is different from the effect which the objects produce upon the eye. This knowledge, indeed, has spread to the general public to the extent that it is common to hear dress colors described as "difficult to photograph," while in general the satisfactory reproduction of colored objects for catalogue illustration and other commercial purposes has been a most serious problem for the technical photographer.

What the commercial and technical photographer requires is a means by which he can reproduce, in monochrome, any colors in any relative brightness which he may desire, and this can be obtained only by using films or plates that are sensitive to all colors, in connection with a series of color filters suitable for the whole range of colors likely to be met with in practical work. For this purpose, we manufacture Eastman Panchromatic Films and the Wratten Panchromatic Plate, these being used with the Wratten Filters. These panchromatic materials are distinguished by the fact that they are completely sensitive to all colors. Ordinary films and plates are sensitive to blue, violet, and ultra-violet. Those which are known as "orthochromatic," in addition to being sensitive to these colors, are sensitive also to the yellow-green, and since this is the chief component of yellows, they are generally said to be sensitive to green and yellow. Panchromatic materials, however, are sensitive not only to the blue, violet, green and yellow, but also to orange and red, so that they are sensitive to all colors which the eye can see.

Suppose that a photographer wishes to photograph labels printed in red, green and blue (see p. 15). Then an ordinary film will photograph the blue as light, the green and red, dark; by using an orthochromatic film the green

COLOR FILMS, PLATES AND FILTERS

will photograph light as well as the blue, but only by the use of a panchromatic plate can the red be photographed as anything but black. It will be realized that red sensitive materials cannot be developed or handled in the ordinary darkroom light. A special safelight must be used, or no light at all.

Eastman Commercial Panchromatic Film has nearly twice the speed of Eastman Commercial Ortho Film but has been specially sensitized to the red as well as to the green and yellow.

The Wratten Panchromatic Plates are made in two varieties. The faster plate, of softer quality, is called the Wratten Panchromatic, while a slower plate, of greater contrast, is termed the Wratten Process Panchromatic, this latter plate being intended for use where great contrast is required, as in photographing labels, or for the preparation of the line and halftone negatives in photo-engraving.

Therefore these panchromatic materials especially the Eastman Commercial Panchromatic Film are fast enough for general work even when filters are used. In fact, under some conditions the Panchromatic Film is faster than the non-color-sensitive materials. Although the Wratten process Panchromatic Plate is somewhat slower its ability to build up great density makes it a very useful plate.

The Need of Light Filters

By using panchromatic materials we can photograph a scene or object so that every color is given its correct relative value in monochrome, but in order to do this a filter must be placed in front or back of the lens. The reason for this is that even panchromatic materials are more sensitive than is the eye, to blue and violet light, in comparison with green and red light, and the way to prevent these colors from exercising an undue effect upon the plate is to use a colored filter which will sufficiently subdue them before they reach the plate.

FOR COMMERCIAL PHOTOGRAPHY

This filter must be accurately adjusted to the sensitive material. It must be sufficiently dark to stop the correct proportion of blue and violet light, and especially it must stop all the invisible but very active ultra-violet light, but it must not absorb too much blue light or quite all the violet light, because otherwise these colors will be reproduced too dark. Three orthochromatic filters, designated by the letter "K", for use with panchromatic films and plates, give the photographer complete control over the degree of orthochromatic correction desired and these are sold by us either singly or in sets.

The K1 is a pale yellow filter requiring only 50% more than the unfiltered exposure. The K1 filter should be used where only a slight correction is needed or where the exposure must be kept down to a minimum.

The K2 is the most generally useful filter. It increases exposure on a panchromatic film or plate about three times, and gives excellent color reproduction. It is the most suitable filter for general work. Where the equipment is limited to only one filter the K2 is the one we recommend.

The K3 filter gives a fully corrected color reproduction and requires about four and one-half times the unscreened exposure on panchromatic films and plates. It is not recommended for use with other materials.

The Reproduction of Color Contrasts

To the eye, objects are distinguished from their surroundings by contrast which may be of two kinds. It may be a tone contrast or a color contrast. Tone contrast can always be correctly reproduced photographically, but the result of the reproduction of a color contrast will depend on the photographic method used.

Consider, to illustrate, two objects one placed upon the other and distinguishable from each other by the eye solely upon their color contrast—such as a bright red apple in a cluster of green leaves. The color contrast to the eye is

COLOR FILMS, PLATES AND FILTERS

marked, although the tone contrast is small, that is, one color is really as dark as the other. Photographed with an ordinary film or plate both reproduce dark and, instead of contrast, a mass of black is recorded. If, now, a panchromatic material is used, with the K3 filter, both colors are reproduced in the same *tone* values seen by the eye: the *contrast* disappears and the colors are represented by a uniform field of gray.

What, then must be done to obtain a satisfactory reproduction of this color contrast? It is quite clear that it is impossible in the case suggested to reproduce the color contrast in a photograph so long as tone values are correctly recorded, consequently we must sacrifice the correct rendering of either the red or the green. If a green filter is used the green will appear lighter and the red darker; if we use a deep orange filter, the red may be lighter, the green darker; and which shall be used must be governed by circumstances. If we over-correct the color contrast, it is usually better to over-correct towards the red (making a bright red, lighter) since red, as a rule, seems to us more brilliant than green.

Again, with perfect orthochromatism, a yellow strawstack against a blue sky may give a result, in which the strawstack cannot be distinguished from the sky. Here again it would perhaps be better to over-correct, though the individual must decide for himself in each case whether color contrasts shall be partly corrected, fully corrected, or over-corrected.

The procedure we have been describing enables us to indicate color contrast, though it is a departure from true orthochromatism.

Color Contrasts for Special Purposes

There is another case of the photography of color contrast, which is to the commercial workers of as great, if not greater, importance and that is the photographing of colored objects to secure the best possible general results for advertising purposes.

If it is desired to photograph a colored object as black, it must be photographed through a filter that will completely absorb the color of the subject. No rays of light reflected from it will then reach the plate and, as a consequence, it will be reproduced as though it were black. For example, consider the label shown on p. 15. If a red filter is used the blue and green will be absorbed and will photograph more or less dark, while the red is transmitted and photographs so well that the white word "negative" is indistinguishable.

If no filter is used, or if a green filter is used, the red will appear black and the black lettering consequently lost. In order, therefore, to properly show all the colors, together with the black and white lettering, it is necessary to use the K3 filter which gives a correct reproduction. But the examples with the red filter and without a filter show how certain contrasts could be obtained if necessary.

The most important application of this method occurs in the photography of furniture, where the results are indeed gratifying. If a piece of polished red mahogany furniture is photographed on an ordinary film or plate, no trace of grain is usually visible. To this plate, both the red and yellow portions of the wood are black; to give increased exposure simply results in the appearance of a plentiful crop of ordinarily invisible scratches in the photograph. If, however, Eastman Panchromatic Films or Wratten and Wainwright Panchromatic Plates, are used with the "A" (orange-red) filter, the results are entirely different; the scratches disappear and the grain of the wood comes up in

COLOR FILMS, PLATES AND FILTERS

the most wonderful way. In fact, so great is the difference that it may seem incredible, to those who have never used panchromatic materials.

In all furniture-photography success depends chiefly upon the selection of the filter for the particular subject to be photographed. Where mahogany is to be photographed, in most cases the greatest contrast can be obtained by the use of the "A" filter, the orange-red color of this filter giving the strongest contrast between the lighter and darker portions of the wood, thus rendering the grain in the most striking way. It must be remembered when photographing furniture for the purpose of catalogue illustration, that the object of the manufacturer is to make the article appear as attractive as possible, and to do this the natural grain of the wood must be shown in the illustration. The furniture can be photographed before being varnished and rubbed, when the results, if not quite so accurate, are attained with much less exposure. The same technique is used.

With yellow woods, such as oak, satinwood, and walnut a red filter is of little advantage, and the "G" contrast filter, which is of a strong yellow color, will be found sufficiently deep.

When photographing inlaid furniture, too much exaggeration must be avoided, and when we have inlaid mahogany of the Sheraton type, it is somewhat difficult to render in its full strength the red grain of the mahogany without at the same time showing yellow inlays too white. The matter must be compromised and the "A", "G" or "K3" filter used, according to the particular subject and the effect required (See p. 16). The effect of the filter can generally be judged by simply looking at the subject through the filter to be used.

For the most difficult cases of very dark, old mahogany or rosewood, it is sometimes necessary to use the "F" (deep red) filter, but this must be regarded as a reserve power, only to be used when absolutely necessary, because

FOR COMMERCIAL PHOTOGRAPHY

the manner in which it over-corrects all lighter tones is liable to give a general impression of exaggeration to the resulting photographs.

Tapestries and carpets are usually photographed with a "K3" filter, but if they contain much yellow, red and also light blues, the results will be found to be too flat, and for such work the "A" filter is more suitable. If a green carpet, with a red design, is to be photographed, and it is desired to clearly pick out the red design from the general light green ground, the green "B" filter will be found most suitable. But where an important piece of work is undertaken, it is generally advisable to try one negative with a "K2" or "K3" filter in order to get an orthochromatic rendering before using a contrast filter, as it is desirable to avoid over-correction unless the subject necessitates it.

Subjects for which a correct orthochromatic rendering is particularly desirable are reproductions of posters, labels and other forms of advertising matter in colors. Posters, for instance, in which the figures of persons are outlined against a bright yellow ground, if reproduced upon an ordinary film or plate, will convince anyone that there are subjects for which the ordinary non-color-sensitive material may not prove all that can be desired. In copying maps, a "K3" filter must be used if the map contains several colors, but in those which more often come to the commercial photographer, such as real estate maps, a contrast filter is frequently required to accentuate some special color in the original. For photographing new houses, and indeed most architectural subjects, the "G" filter with an Eastman Panchromatic Film will give admirable results, avoiding the full tone in which red bricks are too often reproduced, especially in dull or hazy weather.

Sometimes it is necessary to copy a print which has become yellowed with age. As ordinary films or plates are sensitive only to the blue, violet and ultra-violet rays, which are more or less absorbed by this yellow paper,

COLOR FILMS, PLATES AND FILTERS

if a negative is to be made of such a print, the yellow paper will appear dark or gray. If a color sensitive material is used, with a yellow contrast filter, the yellow stain will have no effect and will fail to photograph. It should be noted that the yellow filter to be used for such a purpose should not be an orthochromatic filter, if the best results are required, but one which is much stronger, such as the Wratten "G" filter. An orthochromatic filter is made to photograph objects in their tone values, as seen by the eye, and if the yellow stain is visible to the eye, it will also photograph through the orthochromatic yellow filter. If the yellowed print be examined through the strong "G" filter, the yellow stain of the paper will not be visible. Sometimes however a better result may be obtained with an ordinary plate—it depends upon the nature of the print.

The illustrations on page 18 show photographs of a print which had been splashed with a yellow dye, leaving a conspicuous stain. In the first photograph, made on an ordinary film, the stain appears quite black, while in the second one, for which an Eastman Panchromatic Film and the "G" filter were used, the stain has disappeared.

Another difficulty is encountered in copying prints that are of a brown color, such as found in Sepia, D.O.P., Carbon or re-developed Bromide prints. This brown color has a very strong absorption for the violet light, to which the plate is sensitive, consequently such prints when photographed give negatives having too much contrast or without detail in the shadows. It will generally be found that increasing the exposure will not satisfactorily reproduce such photographs. The obvious course is to photograph them as they are seen by the eye; that is, by means of a fully correcting (K3) filter and a panchromatic film or plate.

A difficult task, without the proper plate and filter, is the photographing of engineers' or architects' blue prints, as it is impossible to obtain satisfactory results by using the ordinary plate. Nor can orthochromatic films, with

FOR COMMERCIAL PHOTOGRAPHY

yellow filters, give the best results, owing to the fact that a great deal of the yellow-green light to which such films are sensitive is reflected by the blue print. Therefore, in order to obtain really first-class results, the "A" or the "F" filter should be used with Wratten Process Panchromatic plates, thus photographing the print by red light, which completely absorbs the blue. With such a plate and filter, the negatives made from blue-prints are in every way as satisfactory as could be obtained from photographing a black and white print in the ordinary way.

The photography of purple or violet typewriting can be accomplished in the same manner, by the use of the Green "B" filter and the Wratten Process Panchromatic Plate. Not only is the purple typewriting reproduced, but any corrections in red will also be shown as black, while if a red filter is used red ink will disappear.

The commercial photographer often receives orders for prints that are to be colored by hand—to show the colors of the subject. In such cases his work will be much easier if the negative is made with a "K3" filter on a panchromatic film. It is impossible to make either a colored print or a colored lantern slide correctly reproducing a subject containing yellows and reds from an ordinary negative. The ordinary plate shows these colors too dark, but the panchromatic film used with the "K3" filter will faithfully photograph all colors in correct relationship to each other, and a print from such a negative can be colored so that the colors will accurately reproduce the colors of the subject.

We can put this whole matter briefly in another way by saying that white light is a combination of all the colors of the spectrum. Objects appear colored because they *absorb* all the colors of the spectrum except their own, which they *reflect*, so that a

Red object absorbs blue and green light; a

Green object absorbs blue and red light; a

Deep Blue object absorbs green and red light; a

COLOR FILMS, PLATES AND FILTERS

Yellow object absorbs blue light; a

Magenta or *Purple* object absorbs green light; a

Light Blue or *Blue Green* object absorbs red light.

If a colored object is looked at or photographed through a filter of a color which it absorbs, it appears or photographs dark, so that with a blue filter red, green and yellow objects all photograph dark and blue, light; blue-prints photograph like black-and-white prints through a red filter; typewriting (purple) through a green filter, and so on.

If a colored object is looked at or photographed through a filter of its own color it appears light and any markings appear well defined. Golden oak shows its grain best through a yellow filter, red polished mahogany through a red filter.

Films and Plates

From the point of view of color-sensitiveness there are three kinds of sensitive materials:

(1) Ordinary materials, such as Eastman Commercial Films, give the same monochrome rendering of colored objects that we see when we look through the deep blue ("C") filter. They are sensitive only to blue and violet light and are but little affected by green or red light.

(2) "Ortho" materials, such as Commercial Ortho Films, when used without any filter, give almost the same rendering of colors as ordinary materials except that they are more sensitive to yellow. But when used with a yellow filter they reproduce yellows and greens quite well, so the various colors are recorded in nearly the monochrome values we see when looking through the green ("B") filter.

(3) Panchromatic films and plates are sensitive to all colors, but when used without any filter, blues photograph too bright. To get tones rendered correctly a "K3" filter must be used and this will suitably record all colors in monochrome. Only panchromatic materials can be used with *Red* or *Orange* filters.

List of Wratten Contrast Filters

The set of light filters for general commercial work consists of eight filters, "K1," "K2" and "K3" being orthochromatic filters, and "G" a deep yellow filter for contrast work; "A," "B," "C" being the standard tri-color set and "F" a deep red filter for special work.

The orthochromatic material referred to is Eastman Commercial Ortho Film.

"Multiplying factor" is the number the exposure without any filter, must be multiplied by to give correct exposure. These figures are only intended as rough indications of the increase in exposure which the use of the filter will entail; the exact factors for the filters vary with each batch of emulsion and are shown on a card enclosed in each box.

NAME	USE	Approximate Multiplying Factors	
		For Eastman Panchromatic Films and Wratten Panchromatic Plates	For Orthochromatic Material
"K1" Very Light Yellow	As a correcting filter when short exposure is of greater importance than full correction.	1½	3
"K2" Light Yellow	For general work with Ortho plates and films. The best single filter for panchromatic materials.	3	6
"K3" Yellow	To obtain full correction with panchromatic films and plates.	4½	12
"G" Strong Yellow	To obtain detail in subjects where the contrasts are in yellow color—such as oak furniture.	6	30
"A" Orange Red	Used only with panchromatic materials. To obtain contrast and detail in subjects of yellow and brown—such as mahogany furniture.	12	
"B" Green	For photographing typewritten letters and rendering greens light and reds dark.	10	12
"C" Deep Blue	To photograph blue as white; greens, yellows and reds dark.	10	5
"F" Deep Red	To photograph blue-prints and reproduce reds light.	24	

Kinds of Filters

Wratten Light Filters are supplied in two forms—the gelatin film filters, which are not protected by glass, and the glass filters, in which the gelatin filters are cemented between pieces of optical glass. Gelatin film filters are used mostly for experimental work. For regular work they are not recommended, as the film is easily marked by the fingers and the filters are apt to deteriorate on prolonged exposure to the atmosphere. Gelatin film filters may be fitted between the lenses or held in a cardboard frame that can be fitted over the lens mount.

It is best, however, for regular work to use filters that are cemented in glass. Glass filters are made circular to be fitted in slip-on cells and also square of any size desired.

Filters in "B" glass, two inches, three inches, and four inches square, can be used in our Adjustable Filter Holders.

The two-inch filter holders are for use on lens mounts measuring from one and one-eighth to one and nine-sixteenths inches outside diameter. The three-inch filter holders are for use on lens mounts from one and eleven-sixteenths to two and three-eighths inches diameter, and the four-inch on lens mounts from two and three-eighths to three and seven-eighths inches outside diameter.

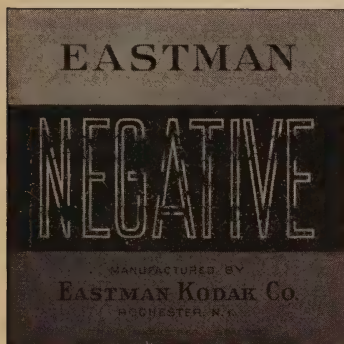
The adjustable Filter Holders will be found especially desirable by all who use several filters, or several lenses on which filters are to be fitted. The filters can be inserted and removed instantly.

We carry a full assortment of all ordinary sizes of filters mounted in slip-on cells. For this form of fitting it is necessary to send us the outside measurement of the lens barrel, and this measurement must be made very exactly. If a pair of sliding calipers cannot be obtained a strip of hard writing paper should be wrapped around the lens so that the ends over-lap and then the two pieces of paper, where they just over-lap, should be cut through, while in position, with a sharp knife.

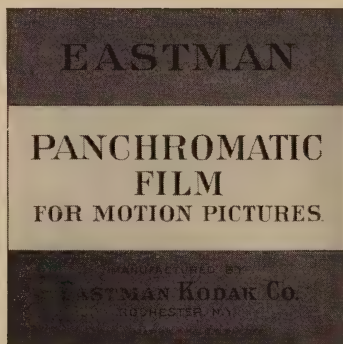
PHOTOGRAPHS OF A LABEL



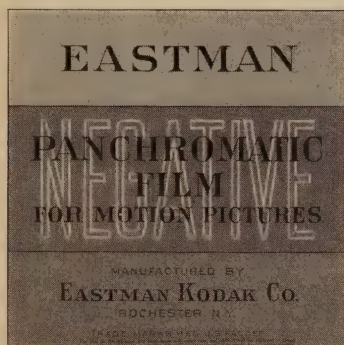
Facsimile of Original



Commercial Film
Without Filter



Commercial Panchromatic
Film and Red "A" Filter

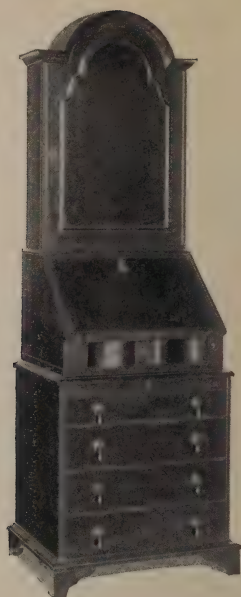


Commercial Panchromatic
Film and "K3" Filter

PHOTOGRAPHS OF FURNITURE



Facsimile of Original



Commercial Film



Eastman Panchromatic Film
with "K3" Filter

PHOTOGRAPHS OF A ROSE



Facsimile of Original



Commercial Film



Eastman Panchromatic Film
with "G" Filter



Eastman Panchromatic Film
with "A" Filter

PHOTOGRAPHS OF VELOX PRINT WITH YELLOW STAIN



Facsimile of Original



Commercial Film



Commercial Panchromatic Film with "G" Filter

FOR COMMERCIAL PHOTOGRAPHY

Quality of Glass Filters

Wratten Filters are supplied cemented in two qualities of glass plates, "A" glass and "B" glass.

Wratten Filters cemented in "A" glass are known as Flats. "A" glass is ground with the same accuracy as the best anastigmat lenses, and the completed filters are about one-half inch thick.

Flats are recommended whenever long focus lenses are used, for three-color process work, where successive exposures must be made without changing the focus of the lens; in telephotography, and also in *all cases* when the very best obtainable results are desired.

"B" glass is selected from the best quality of optical plate glass. Wratten filters in "B" glass are most extensively used and are suitable for all ordinary commercial and landscape photography. We do not carry holders for "A" glass filters in stock, but make them to order.

Developing Panchromatic Films and Plates

Darkroom Methods

There is no doubt that the greatest obstacle to the use of red sensitive materials is the belief that it is difficult to develop them. This belief is chiefly due to the conservatism which instinctively shrinks from any change in the methods to which photographers are accustomed, but we actually find that most people who have accustomed themselves to the use of panchromatic materials experience no difficulty whatever, and even prefer the new methods to those which they formerly used.

There are two methods of developing panchromatic films or plates; they may be developed in a developing tank or covered tray, using the safelight merely for seeing dishes,

COLOR FILMS, PLATES AND FILTERS

etc.; or they may be developed in an uncovered tray a few feet from a Wratten Series 3 Green Safelight. For either method it is convenient to obtain one of the Wratten Series 3 Green Safelights. These safelights are made on the following principle:

The eye is sensitive to all colors if the light is sufficiently bright, but as the intensity of light becomes less, the eye becomes less sensitive to red; and proportionately more sensitive to green; when the green light is very faint, it will be much brighter to the eye than any other light by which it is safe to develop.

When developing a film or plate sensitive to all colors, we must use the light by which we can *see the most with the least possible illumination*, and this condition is realized by the green safelight. These safelights are made of a sheet of glass coated with a bright yellow gelatin film and another sheet coated with a bright green film, bound face to face with a thick sheet of green paper between, the colors being spectroscopically correct.

Wratten Safelights

The various kinds of Wratten Safelights are made with scientific precision. The colors must be, and are, exactly adjusted by us in the spectroscope and by trial with the plates. But it should be remembered that no light is really "safe" if the sensitive plate is exposed to it long enough. The standard we have adopted is an exposure of the dry, sensitive material, for which the safelight is designed, for $\frac{1}{2}$ minute, 3 feet distant from the lamp, the illuminant being a 10-watt lamp if used in the Eastman or Brownie Safelight lamps, and 25-watt if used with the Kodak, or Wratten Safelight lamps. The material is *less* sensitive when wet. Exposure to the safelight in excess of this amount should not be given if fog is to be avoided, but more exposure may be given if the illuminant is weaker.

When you first turn out the white light in a darkroom

FOR COMMERCIAL PHOTOGRAPHY

where there is a green safelight, you will scarcely see the light itself, but if you wait a few minutes, most objects near the light will become plain, and at the end of fifteen minutes you will probably have doubts as to the safety of the light, which has become quite bright. These safelights are $\frac{3}{16}$ of an inch thick and can be made in any size. If the safelight gets very hot, the film will crack off the glass, so that lamps for safelights must be well ventilated. We have designed a special lamp, the Wratten Safelight Lamp, which transmits only reflected light and is properly ventilated. It is described on page 31. Darkroom lamps fitted with ordinary safelights are *not safe for these emulsions* and red light must be absolutely avoided.

Developing

An instruction card is placed in every box. This card is printed in our factory, after actual tests of each batch of films or plates have been made in the laboratory. The card gives the particulars for tray and tank development, the time for both being given at temperatures of 50°, 65°, and 80° F., without danger of frilling. For temperatures in between those given, develop for an intermediate length of time.

The time of development necessarily varies for different batches. The correct time of development for both the tank and tray methods is stated on the instruction card packed in every box. This time is suitable for negatives that will print well on Vitava paper, but may be modified to give stronger or weaker negatives to suit the individual workers by increasing or decreasing the time of development, using our figures simply as a guide.

If tray development is to be used, have your developer ready and a large cover that will completely cover the tray, permitting no light whatever to enter. Pour on the developer and immediately cover the tray, rocking it gently during the time of development. If a green safelight is not used, it is necessary to work in absolute darkness.

COLOR FILMS, PLATES AND FILTERS

For ordinary contrasts, using Eastman Commercial Panchromatic Films or Wratten Panchromatic plates, Formula D-1 developer is recommended.

Pyro-Soda Developer Formula D-1

		Avoirdupois
A	{ Sodium Bisulphite or Potassium Metabisulphite	140 grs.
	{ Pyro	2 ozs.
	{ Potassium Bromide	16 grs.
	{ Water, to make	32 ozs.
B	{ Water	32 ozs.
	{ Sodium Sulphite (E. K. Co.)	3½ ozs.
C	{ Water,	32 ozs.
	{ Sodium Carbonate (E. K. Co.)	2½ ozs.

For use dilute as follows:

Tank Development—

Take 5½ ounces each, A, B and C and add water to make one gallon.

Tray Development—

Take 1 part of A, 1 part of B, 1 part of C, and 7 parts of water.

For developing Process Panchromatic films and plates Formula D-11 is recommended.

Elon-Hydroquinone Contrast Developer Formula D-11

Hot water (about 125° F.)	16 ozs.
Elon	15 grains
Sodium Sulphite (E. K. Co.)	2½ ozs.
Hydroquinone	135 grains
Sodium Carbonate (E. K. Co.)	¾ oz.
Potassium Bromide	75 grains
Cold water to make	32 ozs.

Use full strength at 65°. For less contrast, dilute with an equal volume of water.

FOR COMMERCIAL PHOTOGRAPHY

Fixing

If you use the following acid fixing bath the light can be turned up after fixing has proceeded for three minutes.

Acid Fixing Bath (Formula F-1)

Hypo	16 ozs.
Water	64 ozs.
Dissolve, and add the following hardening solution:	
Water	5 ozs.
Sodium Sulphite (E.K.Co.)	1 oz.
Acetic Acid (28% pure)	3 ozs.
Potassium Alum	1 oz.

If you prefer plain or alkaline hypo, no exposure must be made to the light until fixation is complete. Always use *fresh, strong and clean* fixing baths. *Old and discolored ones are sure to produce trouble.* With the Wratten double coated plates thorough fixing is important, and the plates must not be removed from the fixing bath until it is certain that they are completely fixed.

To make up the hardener, dissolve the chemicals in water at about 100 degrees Fahrenheit in the order given above. The sodium sulphite should be completely dissolved before adding the acetic acid, after the sulphite-acid solution has been thoroughly mixed add the potassium alum. Pour the hardener solution slowly into the cold hypo solution while stirring the hypo solution rapidly. The hypo should be thoroughly dissolved before adding the hardener, otherwise a precipitate of sulphur is likely to form.

For those who prefer a chrome alum formula, the following is suggested:

Chrome Alum Fixing Bath for Films and Plates (Formula F-16)

A. Hypo	2 lbs.
Sodium Sulphite (E. K. Co.)	2 ozs.
Water to make 96 ozs.	

COLOR FILMS, PLATES AND FILTERS

B. Water	32 ozs.
Potassium Chrome Alum	2 ozs.
Sulphuric Acid—pure conc.	$\frac{1}{4}$ oz.

Pour B solution into A solution slowly while stirring A rapidly. This formula is especially recommended for use in hot weather, but it loses its hardening properties in a few days either with or without use, and therefore should be used as soon as possible after mixing. This formula, when fresh, hardens the film more thoroughly than the potassium alum formula, and is, therefore, to be preferred in hot weather, but it should be renewed frequently. Formula F-1 gives satisfactory hardening throughout its active life and as an all around bath is to be preferred.

Hardening Baths

In hot weather the following hardening bath should be used after development and before fixation in conjunction with Formula F-1, or when the bath F-16 does not harden sufficiently.

Chrome Alum Hardening Bath for Films and Plates (Formula SB-3)

Water	32 ozs.
Potassium Chrome Alum	1 oz.

After development rinse the films or plates for one or two seconds and place for two or three minutes in the above bath. Agitate the films for several seconds on first immersing in the hardening bath, otherwise a chromium scum will tend to form on the film, which is very difficult to remove. Then place in the fixing bath. Trouble from stains, blisters and airbells is largely prevented if the film or plates are agitated on first immersing in the fixing bath, and at intervals until fixation is completed.

This hardening bath is a blue-violet color by artificial light, when freshly mixed, but it ultimately turns yellow-

FOR COMMERCIAL PHOTOGRAPHY

ish-green with use. It then ceases to harden and should be replaced with a fresh bath. A freshly mixed and unused bath will keep indefinitely, but the hardening properties of a partially used bath fall off rapidly on standing for a few days.

It is very important to observe the precautions regarding agitation of the film on first immersing in the hardening bath in order to prevent the formation of chromium scum. The scum is produced by the action between the chrome alum and the alkaline developer carried over on the film, but it does not form if the bath is acid. If the film is not agitated the hardener solution in immediate contact with the film becomes alkaline and it precipitates a chromium hydroxide tends to form. Agitation of the film will prevent this. When the bath becomes old, a scum will tend to form even when the films are agitated. The bath should then be discarded.

These films should always be washed with water and wiped with cotton after washing in order to remove any possible traces of scum because once the film is dry it is impossible to remove it.

For full particulars for handling film under hot weather conditions, see the booklet on "Tropical Development."

The Importance of Rinsing

When a film is transferred from the developer to the fixing bath, the alkali in the developer retained by the film neutralizes some of the acid in the fixing bath. When a certain quantity of acid has been destroyed in this way, the fixing bath precipitates white sludge, rendering it useless. The addition of developer also gradually destroys the hardening properties of the fixing bath. Therefore, by removing as much developer as

COLOR FILMS, PLATES AND FILTERS

possible from the film by thoroughly rinsing in water, the life of the fixing bath is much prolonged, while the tendency for stains and blisters to form is very much reduced.

In warm weather it is only possible to rinse for one or two seconds, otherwise the film will soften. If the chrome alum hardening bath above is used, rinsing in water may be omitted, although a previous rinse for a few seconds in water, will prolong the life of this bath also.

The Life of a Fixing Bath

A fixing bath is exhausted either when a sludge forms or when the fixing power of the hypo is reduced to such an extent that there is danger of some silver remaining in the film after fixing for the normal time. Sludging can be prevented by a thorough rinsing after development.

The F-1 and F-16 baths above will completely fix the equivalent of 75—8 x 10 inch films or plates per gallon of solution provided a thorough rinsing water precedes fixation. If the acid hardening bath is used, the fixing bath will not precipitate a sludge as readily, and the equivalent of 100—8 x 10 inch films or plates may be fixed per gallon.

Halation

By the use of film halation is avoided. In order to prevent halation with the Wratten Panchromatic and Process Panchromatic Plates they are now made double coated.

FOR COMMERCIAL PHOTOGRAPHY

Technical Books on the Photography of Colors

The Photography of Colored Objects, 102 pages, bound in board, (new edition)	\$.50
Wratten Light Filters, 82 pages (for scientific workers)	.50
Photomicrography, 44 pages	.15

Prices of Eastman Commercial Panchromatic Film

Size	Prices Include Excise Tax Per Doz.	Size	Per Doz.
3 1/4 x 4 1/4	\$.77	17 x 20	\$22.22
3 1/4 x 5 1/2	1.03	18 x 22	25.88
4 x 5	1.03	20 x 24	31.34
4 1/4 x 6 1/2	1.50	20 x 26	33.92
4 3/4 x 6 1/2	1.55	22 x 24	34.48
5 x 7	1.65	20 x 28	36.54
5 x 8	1.96	22 x 27	38.76
6 1/2 x 8 1/2	2.53	22 x 28	40.20
7 x 10	3.14	20 x 30	39.12
7 x 11	3.66	22 x 30	43.04
8 x 10	3.66	24 x 30	46.96
10 x 12	6.39	25 x 30	48.97
7 x 17	6.39	24 x 36	56.39
11 x 14	9.18	24 x 40	62.63
8 x 20	9.48	28 x 36	65.77
12 x 20	14.38	30 x 34	66.54
14 x 17	15.57	26 x 40	67.83
16 x 20	20.88	30 x 40	78.24
	30 x 60.		\$117.37

Eastman Commercial and Commercial Ortho Film

Size	Prices Include Excise Tax Per Doz.	Size	Per Doz.
3 1/4 x 4 1/4	\$.67	8 x 10	\$ 3.30
3 1/4 x 5 1/2	.93	8 x 20	8.61
4 x 5	.93	10 x 12	5.77
4 1/4 x 6 1/2	1.34	11 x 14	8.30
4 3/4 x 6 1/2	1.39	12 x 20	13.04
5 x 7	1.50	14 x 17	14.12
5 x 8	1.75	16 x 20	18.97
6 1/2 x 8 1/2	2.27	17 x 20	20.15
7 x 10	2.84	18 x 22	23.50
7 x 11	3.30	20 x 24	28.45
7 x 17	5.77	20 x 26	30.82

COLOR FILMS, PLATES AND FILTERS

Size	Prices Include Excise Tax		Size	Per Doz.
	Per Doz.	Size		
20 x 28	\$33.19	24 x 36	\$51.23	
20 x 30	35.57	24 x 40	56.90	
22 x 24	31.34	25 x 30	44.48	
22 x 27	35.20	26 x 40	61.65	
22 x 28	36.54	28 x 36	59.79	
22 x 30	39.12	30 x 34	60.46	
24 x 30	42.68	30 x 40	71.13	
	30 x 60	\$106.70		

The 5 x 7, 6½ x 8½ and 8 x 10 sizes are put up in 2 dozen packages at \$2.99, \$4.54 and \$6.60 respectively.

Note—Special sizes of Eastman Film will be furnished at approximately proportionate prices to the next larger size.

When furnished in quantities of less than regularly listed packages, the price will be figured per sheet, at proportionately the rate per dozen sheet package, plus additional charge for packing, about 10 per cent.

Prices of Wratten Panchromatic and Process Panchromatic Plates Double Coated

Size	Prices Include Excise Tax		Size	Per Doz.
	Per Doz.	Size		
3¼x4¼	\$.83	10 x 12	\$ 7.25	
3¼x5½	1.14	11 x 14	10.40	
4 x 5	1.14	14 x 17	17.85	
4¼x6½	1.71	12 x 20	28.20	
5 x 7	1.86	16 x 20	31.83	
6½x8½	2.85	18 x 22	44.25	
8 x 10	4.14	20 x 24	55.11	
7 x 11	4.14			

Wratten Filters

Gelatin Film		Cemented in "B" Glass		Unmounted Circles or Squares in A Glass
Inch		Unmounted Circles	Squares	
¾	\$.20	\$1.15	\$1.15	\$2.40
1	.20	1.30	1.30	2.55
1⅛	.20	....	....	2.85
1¼	.20	1.45	1.45	2.85
1⅝	.20	....	....	3.15
1⅞	.20	1.65	....	3.15
1½	.25	1.65	1.65	3.15
1⅞	.25	....	....	3.30
1⅞	.30	1.75	....	3.30
1⅞	.30	....	....	3.45
1¾	.30	1.90	1.90	3.45
1⅞	.35	2.10	....	4.20
1⅞	.35	....	....	4.20
2	.40	2.10	2.10	4.20
2⅛	.45	2.25	2.25	4.50

FOR COMMERCIAL PHOTOGRAPHY

Wratten Filters (Continued)

Inch	Gelatin Film	Cemented in "B" Glass			Unmounted Circles or Squares in A Glass
		Unmounted Circles	Squares	Mounted in Metal Cells	
2 1/4	.55	....	2.85	6.00	....
2 1/8	.55	....	....	6.00	....
2 3/8	.60	....	2.85	6.00	....
2 1/2	.65	2.85	2.85	6.00	18.00
2 5/8	.70	....	....	7.50	....
2 3/4	.80	....	3.75	7.50	....
3	.90	3.75	3.75	7.50	25.50
3 1/4	1.25	....	3.75	7.50	....
3 1/2	1.25	5.65	5.65	....	31.50
4	1.60	6.75	6.75	13.50	39.00
4 1/2	1.70	....	9.40	....	45.00
5	1.70	....	9.40	....	60.00

Specify in your order whether Film Filter or Filter Cemented in "B" Glass is desired.

Note: Where no prices are quoted on Cemented Filters, "B" Glass, Circulars or Squares, Unmounted, in the schedule above, the cost will be figured at an increase of 50% over the next larger listed size.

Note: When ordering "B" glass filters for use in mounts already purchased give the exact diameter of the filter required. This is necessary because the size varies according to the diameter of the cell in which it is to be used.

Standard Sets of Filters 3 Inches Square

Commercial set of 8—A, B, C, F, G, K1, K2, and K3.

Price per set, case included. In "A" Glass (Flats).	\$204.00
Price per set, case included. In "B" Glass	35.00
Gelatin Film only	7.20

Commercial set of 3—K3, G and A. Specially suitable for photographing oak and mahogany furniture.

Price, per set, case included. In "A" Glass (Flats)	\$ 76.50
Price, per set, case included. In "B" Glass	16.50
Gelatin Film only	2.70

Sets of A, B, and C—For three Color Photography.

Price, per set, case included. In "A" Glass (Flats)	\$ 76.50
Price, per set, case included. In "B" Glass	16.50
Gelatin Film only	2.70

We make upwards of 100 different filters and if a filter is required for a special purpose we can probably supply it. *Condensed Price List of Filters sent on request.*

Adjustable Filter Holders

For 2-inch Square Filters. Will fit lens mounts 1 1/8 to 1 9/16 inch diameter	\$1.25
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COLOR FILMS, PLATES AND FILTERS

For 3-inch Square Filters. Will fit lens mounts $1\frac{1}{8}$ to $2\frac{3}{8}$ inch diameter	\$1.50
For 4-inch Square Filters. Will fit lens mounts $2\frac{3}{8}$ inch to $3\frac{7}{8}$ inch diameter	2.50

Filter Test Chart

Consists of 12 small viewing filters, mounted in cardboard, for examining the subject to determine which filter should be used.
 Eastman Filter Test Chart \$.75

Wratten Safelights

These safelights consist of one or two sheets of glass coated with a colored gelatin film, which transmits a perfectly safe light in which to handle the sensitive material for which they are recommended.

Series 00. Yellow light for use with D. O. P. papers, such as Vitava, etc.

Series 1. An orange safelight for use with ordinary, medium and extra rapid films or plates which are not color sensitive. Consists of yellow and orange coated glass, with red paper between.

Series 2. A safelight for extra rapid and orthochromatic films or plates, which are sensitive to green but not to red. This safelight consists of yellow and violet-colored glass with deep red paper between.

Series 3. This is the green safelight for use with the red-sensitive panchromatic material. It gives a faint illumination, which grows quite strong as the eyes become accustomed to it. This safelight consists of yellow and green coated glass with green paper between.

Series 4. Bright green safelight for use with ordinary films or plates, for those who are unable to use a red light. Not safe for orthochromatic materials.

PRICE WRATTEN SAFELIGHT. (Any Series)

5 x 7 . . . \$.75	8 x 10 . . . \$1.25	10 x 12 . . . \$1.75
2½ dia. and 3¼ x 4¾ (for Brownie Safelight Lamp) per pair . . .	.65	

Special sizes supplied at an advance of $33\frac{1}{3}\%$ above the price of next larger size from which they can be cut.

Wratten Safelight Lamp



No. 1 Wratten
Safelight
Lamp

The Wratten Safelight Lamp is radically different in construction from the ordinary darkroom lamp in that none but reflected light is permitted to pass. This is accomplished by building the lamp practically twice the height of the ordinary lamp.

The electric bulb is placed inside the lamp at the top. By means of a white enameled curved reflector the rays of light from the lamp above are evenly diffused over the surface of the safelight which is fitted to the lower portion of the lamp front.

The safelight glass is eight by ten inches, affording ample illumination for the inspection of large films or plates.

The Wratten Safelight Lamp is constructed for use with electric light only, and includes electric lamp attachment with six feet of cord and plug and one safelight.

WRATTEN SAFELIGHT LAMPS ARE MADE IN TWO STYLES:

No. 1 is fitted with a safelight, and also with a sheet of opal glass. The opal glass furnishes white light illumination. It is covered with a light-tight slide when safelight illumination only is desired.

No. 2 is fitted with safelight only.

In ordering, specify which series of safelight is desired. If not specified, Series 2 will be furnished.

The Kodak Safelight Lamp is similar in principle to the No. 2 Wratten lamp but is smaller.

The Eastman Safelight Lamp carries a 5 x 7 safelight and has a screw plug fitting any droplight or wall socket. A useful lamp where shelf space is limited.

The Brownie Safelight Lamp screws into an electric



No. 2 Wratten
Safelight
Lamp

COLOR FILMS, PLATES AND FILTERS

light socket and is little larger than the electric bulb it holds. Very desirable when working in close quarters.

THE PRICE

(Including one Wratten Safelight of any Series.)

Wratten Safelight Lamp No. 1, 8 x 10	\$10.00
Wratten Safelight Lamp No. 2, 8 x 10	8.00
Kodak Safelight Lamp, 5 x 7	3.50
Eastman Safelight Lamp, 5 x 7	3.00
Brownie Safelight Lamp, Circular end 2½ dia. and side size 3¼ x 4¾, Safelights, any series included	1.75

All prices are subject to change without notice

EASTMAN KODAK COMPANY,
ROCHESTER, N. Y.



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